

Potential from fields and equipotentials

AP Physics C (Mechanics and E&M, calculus-based) · Lab answers

The answers use the sample data. Your own numbers will vary, but the gradient should be close to the battery voltage divided by the electrode separation and the sideways readings should be nearly equal.

Level: AP Physics C (Mechanics and E&M, calculus-based) · **Curriculum:** AP PC:E&M Unit 9

Question 1 Plot the graph

The points lie close to a straight line sloping downward from 4.9 V at 4 cm to 1.3 V at 16 cm, so **V decreases linearly with x**.

Question 2 Gradient and field

Gradient = $(1.3 - 4.9)/(0.16 - 0.04) = -3.6/0.12 = -30 \text{ V/m}$, so **$E \approx 30 \text{ V/m}$** , from $E = -dV/dx$.

Question 3 Direction of E

V falls as x increases, so the field points **along +x**, away from the + electrode toward the – electrode.

Question 4 Compare with theory

Voltage/separation = $6.0/0.20 = 30 \text{ V/m}$. The measured **30 V/m agrees with the expected 30 V/m** to within the scatter of the data.

Question 5 Equipotential check

V is the same, within 0.1 V, 2 cm either side of the centre line, so the line of constant potential runs **across the tray, perpendicular to E**.

Question 6 Uncertainty

Fractional uncertainty in ΔV is $0.14/3.6 = 4 \%$ and in Δx is $0.003/0.12 = 2.5 \%$, giving about 5 %, so **$E = 30 \pm 2 \text{ V/m}$** .

Question 7 Reducing error

A longer tray makes the central region more uniform, and a probe held in a clamp removes hand movement. Reading each point three times and **averaging** reduces random scatter.